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Japanese Patent: PUNCTURE SEALANT COMPOUND

Patent Application by Bridgestone Tire Company

Application Date: August 21, 1972

Issued: April 13, 1974

Translated by Dr. Noboru Tokita

1) Name of Invention

Improved Puncture Sealant Compound.

2) Claim

The component of this puncture sealant compound is 100 parts of rubber which contains more than 30% of ethylene-propylene rubber or ethylene-propylene diene rubber, and 50 to 500 phr of polybutadiene and 5 to 700 phr of inorganic filler.

3) Detail of this Invention

It has been tried to seal the hole after the nail was out by soft rubber-like material which was coated on the inside of tire. Example of this type of patent is by Goodrich Co., and patent number of these patents are: sho 26-6934 and sho 34-10934. Through inventor's examination, however, these compounds were not satisfactory to seal the hole because of the lack of stickiness of the compound. In order to improve the stickiness of the compound, sometimes oil addition was tried. However, by increasing the oil content the compound becomes too soft and flows during the rotation of tire and also the separation of oil and rubber will hamper the sealant capability. Also it is quite difficult to process such a very sticky material. The purpose of this invention is to improve the puncture sealant capability and also to make the process easier. This compound contains 100 parts of rubber which has more than 30% of EPR and EPDM and 50 to 500 phr of polybutadiene and 5 to 700 of inorganic filler. The ethylene propylene rubbers used are: EP rubber, dicyclopentadiene, cyclopentadiene, 1-4 pentadiene, 2-Methyl-1-4 pentadiene, ethylidene-norbornene. Content of diene is 0.5 to 15%. A certain part of EPDM or EPR will be replaced by natural rubber, polybutadiene rubber, styrene polybutadiene rubber, chloroprene rubber, acrylonitrile butadiene rubber, isoprene rubber. However, through increasing the content of these rubbers, the sealant capability is going to decrease. Accordingly, the amount of EPDM is desirable more than 30%. Most desirable content is more than 50%. Among the rubbers described above, natural rubber is more desirable for the resistance to flow and tackiness. As far as the polybutene is concerned, the number of its molecular weight is more than 1000 and less than 5000. The content of polybutene is 50 to 500 phr for 100 parts of rubber or 100 to 500 phr polybutene with some oil. As far as the inorganic filler is concerned, 5 to 700 phr is recommended. However, for the puncture sealant, most desirable component is 25-300 phr for the inorganic filler, carbon black, calcium carbonate, magnesium carbonate, silica, etc. The diameter of this filler is less than 500 millimicron. Moreover, to improve puncture sealant performance small

amount of organic short staple fiber must be mixed to improve the resistance to flow, or antioxidant and also vulcanizing agent added. As far as process is concerned, the roll mills in normal rubber industries can be used and internal mixer is also available. This compound will be extruded very easily through a normal extruder. The puncture sealant produced by this process would be sheeted out, would be laminated on the inner side of the tire to cover all tread, shoulder and part of sidewall. This compound can be used for direct coating of the tire without any outercoating because of the suitable viscosity of this compound. However, the extruded will be covered in sandwich structure and then put into the tire building machine as shown in Figure 4. The entire tire will be cured during the tire molding process.

EXAMPLE NO. 1

The recipe of this compound is:

EPDM (Sumitomo Esprene 501)	100
Carbon Black	80
Polybutene	150
Staple Nylon (2-4mm)	2.5

This material was mixed by a three roll mill, then extruded into a sheet, the thickness of which is 3.5 millimeter. The sheeted material is of the bias belted tire, size C78-14. This compound was compared with B. F. Goodrich compounds: sho 26-6934 and sho 34-10934. In Table 1 the third and last column are Goodrich compounds respectively. The examination has been done by static and dynamic tests. In the case of static test, the nail, diameter of which is 1.8 to 3.8 millimeter length is 30 to 90 millimeters. Four different kinds of nails were sticken into the tread groove section, then kept for 10 minutes in this condition and then pulle out. The tire number that the pressure is completely zero was counted. Seven times test for each kind of nail were done so total tire number wa 28. For the dynamic test, the nail - the diameter of which is 2.7 mm length is 65 mm - was sticken into the tread groove completely. This ti was rotated by rotating drum. For first 30 minutes the speed of tire i 80 kilometer per hours then stepped up to 100 kilometer per hour next five minutes, then next 5 minutes the speed is 120 kilometers per hour, so 20 kilometer per hour step-up for five minutes in tire. This step-up was continued until the nail was out by centrifugal force. In most case the nail was out at 130-160 kilometer per hour. After the nail was out, immediately rotation would stop and measure the tire pressure so the dynamic test is a total 7 tire.

Translator's Note: In Table 1, the data of static-dynamic tests are writte

Bridgestone compound is listed in the 2nd column, Goodrich compounds ar in 3rd and the last column. Bridgestone compounds show no fail, on the contrary the Goodrich compounds both fail completely.

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EXAMPLES 2-7

The processability and puncture sealant capability as a function of the type of rubber were examined. In this experiment, rubber parts = 100, polybutane 150; (Furukawa chemicals (HB 1000)), carbon black 50, mixed by roll mill then extruded and cooled down. Extrusion processability was judged by the extruded appearance. This extruded sealant was covered by inner liner compound in a sandwich structure, then dropped onto the tire builder drum and the entire tire was cured in mold. Static and dynamic tests were examined. In this case, about 120 kilometer per hour, all nails were out. The result is shown in Table 2. As shown in Table 2, the compound made by EPR EPDM is superior.

Translator's Note: Table 2 shows both processability and sealant performance. Double circle ◎ shows very good extrusion processability and the number means the number of failure. Examples 2-3 (this is EPR and EPDM 100%) and Example 4 (this is EPDM, natural rubber 50/50.) both show superior.

EXAMPLES 8-13

In this case the ratio of EPDM (Esprene 501) and natural rubber is 60/40. Nylon staple fiber (2.5 phr) is mixed with the above rubber, then blended with polybutene and calcium carbonate as shown in Table 3. This compound was laminated inside the bias tire, then examined by dynamic test. In Example 13 accelerator dibenzotertyldisulfide 0.5, diphelganezone .25 and sulfur 0.5 were added to the above sealant recipe. This curative addition compound is sandwiched, then cured in the mold as entire tire.

Translator's Note: Table 3 shows that the polybutene content 200, 300 is the best. Example 13 is polybutene 300, calcium carbonate 150 and shows no failure. The Figure 1 is a cross-section of the extruded sealant. Figure 2 shows the picture laminated inside of tire. Figure 3 shows the sandwich structure. Figure 4 shows the sandwich structure sealant installed inside the tubeless tire.

Finally English translation of abstract of this patent:

Puncture Preventing Rubber Compositions — Bridgestone Tire Company
April 13, 1974

Puncture resistant rubber compound contained EPR EPDM or rubber blend content over 30% EPR or EPDM or rubber of 100, polybutene, 50-500 and inorg- filler 5 700 parts. For example a mix of Esprene 501 100 phr, carbon black 80, polybutene 150 and nylon staple 2-4 mm long 2.5 parts was extruded to 3.5 mm thick which was laminated to the inner surface of belted bias tire. The tire had better puncture resistance (nail inserts test) than that with a puncture preventing layer made of SBR or butyl rubber.

TABLE – 1 (Number means weight %)

Recipe	Bridgestone Exp. 1	BF Goodrich # 1	BF Goodrich 2
EPDM	100	—	—
SBR 1712	—	137.5	—
Butyl Rubber	—	—	100
Oil (Arom)	—	20	—
Polybutane	150	20	25
Resin	—	18	—
Fe_3O_4	—	60	50
Carbon Black	80	—	—
ZnO	—	3	—
Phthalic Acid	—	5	—
Anti Fatigue	—	2	2
Mercaptobenzothiazole	—	—	0.4
?	—	—	0.4
Staple Fiber	2.5	—	—

Results (No. of Tire 100% Pressure Down)

1) Static Test (Tire Total # 28)			
After 5 MIN	0	24	23
" 24 hrs	0	28	28
2) Dynamic Test (Tire # 7)			
After 5 MIN	0	6	7
" 24 hrs	0	7	7

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TABLE-2

Experiment #	Rubber	Extrusion Processability	No. of Tire of 100% Pressure Down: Static (# 28)	No. of Tire of 100% Pressure Down: Dynamic (# 7)
BS #2	EPR	◎	4	0
BS #3	EPDM	◎	3	0
Comparison 3	SBR	×	28	7
" 4	BR	×	28	7
" 5	CR	×	28	7
" 6	NBR	×	28	7
" 7	NR	△	28	7
BS #4	EPDM/NR=50/50	◎	2	0
" #5	EPDM/NR=30/70	△	4	0
#6	EPDM/SBR=50/50	○	3	0
#7	EPDM/SBR=30/70	△	5	0

◎ Very Good Extrusion
○ Marginal
△ Bad
× Very Bad

TABLE-3 (phr)

Experiment #	Polybutane	$CaCO_3$	# of Tire of 100% Pressure Down (out of 7)
Comparison #8	50	—	6
BS #8	50	25	2
" #9	100	50	1
" #10	200	100	0
" #11	300	150	0
" #12	500	300	2
Comparison #9	500	750	5
BS * #13	300	150	0

* 149°C 40 MIN Cure

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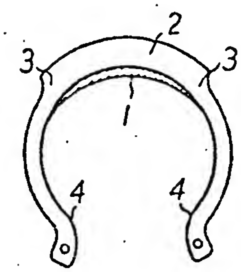
ム組成物を直接チューブレスタイヤの内面に貼りつけた状態を示すチューブレスタイヤの横断面図、第3図は本発明のパンク防止用ゴム組成物を保護ゴム層でサンドイッチ状に包みこんだ状態を示す横断面図、第4図は第3図のゴム複合体をチューブレスタイヤに用いた状態を示すチューブレスタイヤの横断面図である。

1…パンク防止用ゴム組成物、2…タイヤトレッド部、3…ショルダー部、4…タイヤの内面、インナーライナー部、5…保護ゴム層。

第1図

第2図



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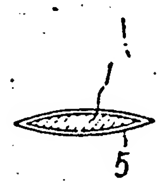
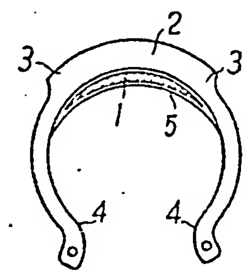
第3図



第4図



5. 添附書類の目録

(1) 明　細　書　1通
(2) 図　　　面　1通
(3) 願　書　副　本　1通
(4) 委　任　状　1通
(5) 出願審査請求書　1通

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